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Too far to go on? Distance to school and university participation

by Marc Frenette

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Too Far To Go On?
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Aussi disponible en français

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Abstract

This study assesses the role of geographic distance to school in the probability of attending university shortly after high school graduation. Students who grow up near a university can save on costs by staying home to attend the local university, and thus may be more likely to attend. Using the Survey of Labour and Income Dynamics (SLID) and a small (publicly available) database of Canadian university postal codes constructed by the author, the straight-line distance between the homes of high school students prior to graduating and the nearest university is estimated using a special postal code conversion file that calculates the geographic co-ordinates (latitude and longitude) of postal codes. After controlling for family income, parental education, and other factors associated with university participation, students living "out-of-commuting distance" are far less likely to attend than students living "within commuting distance" are. Distance also plays a role in the relationship between university participation and its other correlates, such as family income and sex.

Keywords: University participation, distance to school

1. Introduction

Higher educational attainment has long been associated with higher earnings. A recent meta-analysis by Card (1999) concludes that even after controlling for possible ability and sample selection biases related to the acquisition of higher schooling, the annual rate of return to an additional year of schooling lies in the general range of 6% to 10%. In Canada, Vaillancourt (1985) and Bar-Or, Burbidge, Magee, and Robb (1995) find that a post-secondary education is associated with higher earnings, while Finnie (2000) finds that university graduates earn considerably more than college graduates do.

The importance of a university education has prompted some researchers to investigate issues surrounding university access. If students who aspire to attend university are disadvantaged in accessing university due to unfavourable family background characteristics, then the potential role of education as a source of social mobility is impeded. Two aspects of family background characteristics that have been examined are family income and parental education. Several studies suggest that students from higher income families have a higher probability of attending post-secondary schools (Mehmet 1978, Meng and Sentence 1982, and Christofides, Cirello, and Hoy 2001). Mehmet (1978) goes one step further to conclude that even though poorer families pay less into the Ontario post-secondary education system, the differential use of the system across the income distribution is enough to make the system regressive. Studies on the relationship between parental education and university enrolment conclude that students with more highly educated parents have a higher probability of attending university (see Butlin 1999 and Christofides, Cirello, and Hoy 2001.

This study looks at another source of variation in university access: *distance to school.* Students raised in a family situated near a university have the obvious cost-saving alternative of staying at home while attending the local university, thus avoiding the added living and moving costs associated with leaving the nest to attend school. Students living "out-of-commuting distance" don't have this option, and may thus be less likely to attend university, especially if they are from a lower income family. One factor that may reduce the access gap across the income distribution is the Canada Student Loan Program (CSLP)[1]. In very broad terms, the CSLP bases loan amounts on the applicant's needs (i.e. direct costs associated with university enrolment such as tuition, books, living and moving costs, etc.) and resources (student savings, parental contribution, scholarships, bursaries, etc.). Holding costs constant (say by only considering students who stay at home to attend the local university), students from a lower income family would generally be assessed to have lower resources, and would thus qualify for a larger loan amount. Considering the case of students who live too far too commute to university, a lower income student would also receive a larger loan amount than a higher income student (since they have lower resources), but now the assessed need would be higher for both students (i.e. both would have to leave home and pay the added living and moving costs). If students in lower income families are not willing to take on the heavier debt load, then it is quite possible that the access gap across the income distribution is larger among students who live further away from university.

[1] For a much broader description of the CSLP, see Finnie and Schwartz (1996).

The available evidence on the relationship between geographic distance and post-secondary access is scant at best. In lieu of a distance variable, many studies have used an urban/rural dummy variable in analyzing university or post-secondary participation (Kane and Spizman 1994 in the U.S.; Butlin (1999) and Christofides, Hoy, and Cirello (2001) in Canada). Although these studies make no direct inferences about distance *per se*, it may be tempting for the reader to assume that urban residents are closer to a university, and that rural residents are further from a university. This is not necessarily the case, however, as some universities are accessible to nearby rural residents who might be willing to commute. Conversely, some smaller urban areas are not served by a university. Other studies have taken advantage of an available distance variable. In the U.S., Card (1995) uses a variable indicating the presence of a four-year college (equivalent to a Canadian university) in one's local labour market in 1966 as an instrument in estimating the returns to schooling in future years. To justify the use of college proximity as an instrument in studying the returns to schooling, Card shows that students who grew up in an area with a four-year college nearby ended up with about one more year of schooling on average. In Canada, Andres and Looker (2001) find that high school students from the late 1980s in Nova Scotia and British Columbia were less likely to attend university if they lived further away (outside of reasonable commuting distance). The current study will extend this analysis to a national scope, putting the focus not only on the extent of the geographic disadvantage in university participation, but on how distance to school affects the relationship between university participation and other characteristics, such as family income, parental education, and sex.

For several reasons, the primary focus of this study is on university participation, as opposed to participation in any form of post-secondary schooling. First, universities are generally more clustered around major centres (thus raising accessibility issues). Furthermore, university graduates earn more than workers with lower levels of schooling do. A university education may thus be viewed as a first option for many students, holding all else constant. And finally, there are several other forms of post-secondary institutions in Canada, such as community colleges, CEGEPs, trade/vocational schools, private business colleges, etc. A database containing the geographic co-ordinates of all other post-secondary institutions is not yet available.

Briefly, the results of the study indicate that for Canada as a whole, 19% of the population live beyond 80 km of straight-line distance from a university (beyond commuting distance for most) and 13% live between 40 and 80 km from a university (perhaps beyond commuting distance for many). These aggregate numbers mask the tremendous variations across provinces. More than 50% of Saskatchewan residents and more than 40% of Newfoundland residents live more than 80 km from a university. Conversely, a much smaller proportion of the population in Ontario (9%), Nova Scotia (13%) and Prince-Edward Island (14%) live beyond 80 km from a university. After controlling for family income, parental education, and other factors associated with university participation, students who live more than 80 km from a university are only 58% as likely to attend university as students who live within 40 km from a university. Even students who live between 40 and 80 km from a university are only 69% as likely to attend as students who live closer. Collectively, 35% of high school students live beyond 40 km from a university, and are only 63% as likely to attend as students living closer. Nevertheless, students living further away from a university are more likely to attend a non-university post-secondary institution, so that on balance, overall post-secondary participation rates are similar to students living closer to universities. In general, university participation is greater among students from upper income families, students with at least one parent

with a university degree, and females; however, the extent to which these students have an advantage in university participation is highly dependent on distance to school. Within 40 km from a university, students from upper income families are 1.9 times as likely to attend as students from lower income families. Beyond 80 km from a university, however, the ratio rises to 5.6. The relative probability of attending for students with and without a university-educated parent is the same regardless of distance to school. That is, after controlling for income, students with a university-educated parent are just as deterred by distance as students without a university-educated parent are. Within 40 km from a university, females are 1.4 times as likely to attend as males, but there is virtually no difference beyond 80 km.

2. The data

Since this study looks at university participation as a function of distance to school, the first step consisted of identifying a group of students who are "at risk" of attending university in the near future. Information on students is garnered from the Survey of Labour and Income Dynamics (SLID). SLID is a longitudinal household survey that uses the Labour Force Survey (LFS) as a sampling frame. Each panel in SLID is interviewed for up to six years, and a new panel is added every three years. The first panel was interviewed from 1993 through 1998; while a second panel has been interviewed from 1996 through 1999 (two more follow-up interviews remain). A third panel started in 1999, but it is not used in this study. SLID consists of two surveys conducted each year: a labour survey (in January) and an income survey (in May)[2]. All economic family level information is gathered for the family as of December 31st of the reference year.

The advantage of using a longitudinal data source such as SLID is that one can recover information on the family the student lived with prior to graduating from high school. Cross-sectional studies that correlate family income and university participation cannot always identify the family of the student prior to graduating from high school unless retrospective questions are asked. This can be particularly important in assessing the role of family income since students who leave home to attend university will often form their own economic family unit and will most likely have a lower family income than the family they lived with prior to graduating from high school[3]. Even more importantly for the purposes of this study, the student's geography while in high school can only be accurately recovered with longitudinal data. While in high school, 98% of students lived in a family with a member that was at least 17 years or older than the student. Two years later, when some students may have left to attend university (and did not return home for a substantial period of time during the year), only 89% lived with someone at least 17 years or older than the student.

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[2] Most respondents actually give Statistics Canada the right to try to match them to tax records, thus avoiding an interview and reducing response error for the matched cases.

[3] This is certainly true if the student lives away from their parents' home throughout the entire year. In cases where the student comes back at some point in the year, interviewers in the labour force survey (the sampling frame SLID) are instructed to include students in their parents home if they have spent 30 or more days there in the last 12 months. Occasional visits (such as over the Christmas holidays) would generally not count towards the students living with their parents, but longer stays (such as coming back for the summer) may count.

In most provinces, students wishing to attend university are normally required to complete a high school diploma, which takes 12 years of elementary and secondary schooling to complete. Students who just graduated from high school are thus "at risk" of attending university in the near future. There are two notable exceptions to this norm. First, students from Ontario in the 1990s had to complete a grade 13 (Ontario Academic Credits, or OACs) prior to attending an Ontario university. Since many students who complete their OACs have already decided to attend university, it would be more appropriate to base the Ontario sample on a group of pre-OAC students. The second notable exception is Quebec, where students wishing to attend a Quebec university must first graduate from high school after the fifth cycle of secondary schooling (11 years of elementary and secondary schooling), and then have to complete the general stream of CEGEP (Collège d'enseignement générale et professionel), normally lasting two years. Again, the sample in Quebec should be based on pre- CEGEP students.

To account for the asymmetries in the schooling systems, the final sample consists of all students between the ages of 15 and 21 who attended high school in the year in question and are a minimum of two years away from attending university under normal circumstances. The choice of two years was necessitated by the two years separating Quebec high school graduates from university. For students outside of Quebec and Ontario, students are at risk of attending university in two years after completing grade 10. For Quebec and Ontario students, they are at risk of attending university in two years after completing grade 11. In the end, we look at all students who are (normally) two years away from attending university between 1993 and 1997 (year "t") and observe whether or not they had attended university by year "t+2"[4,5,6].

The second step was to create a database of universities that are "at risk" of being attended by the high school students in the near future. This database was constructed from the web site of the Association of Universities and Colleges of Canada (AUCC)[7]. The web site lists the postal codes of its member universities and university colleges in Canada, which are all publicly funded, as well as various other descriptive facts about each institution. The selection criteria consisted of all degree granting institutions that are of interest to the general student population. This includes any non-

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[4] Of course, students in one province may choose to attend a university in another province. For example, students in Ontario may leave after obtaining their grade 12 high school diploma and attend a university in New Brunswick the following academic year (one year earlier than what is normally possible if the student had stayed in Ontario). This possibility is taken into account by looking at university participation at any time within the next two years.

[5] One other consideration of note is that many students choose to wait a year before attending university, either to travel, to save money for tuition, or to decide whether or not they actually want to go to university. To account for this possibility, separate estimations were performed on university participation up to and including year "t+3", which came at the cost of losing almost 40% of the sample (since we obviously lose one of the "at risk" years – namely, 1997). Although university and non-university participation rates rose substantially by looking at an extra year out, the rise was roughly proportional across the distance thresholds used in this study.

[6] Note that Quebec students may have already moved out of the home by December 31st (to attend CEGEP or otherwise) of the year in which they graduated high school (t), so we must look at the previous year (t-1) to capture family characteristics. Since the SLID data begins in 1993, year "t" in Quebec thus refers to any year between 1994 and 1997.

[7] The web site can be visited at http://www.aucc.ca.

theological, non-military institution offering undergraduate degree programs from a wide range of disciplines (i.e. not just arts or just sciences) that could not otherwise be classified as a "special interest" school (e.g. excluding "distance" institutions, institutions aimed at serving the needs of aboriginals, etc.). In total, 71 of the original 101 institutions were selected in the final sample. The 71 selected institutions accounted for about 91% of the total undergraduate student body among member institutions according to the most recent data available on the AUCC web site (no earlier than the 1998-99 academic year for any institution)[8]. The full database appears in the appendix.

The final step was to calculate the distance between the students's home prior to graduating from high school and the nearest university. The geographic co-ordinates (latitude and longitude) of students are derived from the postal codes of households by using the residential version of Postal Code Conversion File Plus (PPCF+), a program that converts six character postal codes into various geographic units, including latitude and longitude. University geographic co-ordinates were calculated by using the institutional version of the PCCF+. Using spherical geometry, and assuming the earth to be a perfect sphere with a radius of 6,370.997 km, the formula for the straight-line distance (in km) between the student's home and the nearest university is:

*(1) Distance = 6,370.997*arcos[sin(s_latrad)*sin(i_latrad)+cos(s_latrad)*cos(i_latrad)*cos(s_longrad-i_longrad)]*

Where "latrad" is the latitude in radians, and likewise for "longrad". The geographic co-ordinates (in degrees and decimals) were converted to radians by dividing by 57.29577951. Note that "s_" denotes the student's location and "i_" denotes the institution's location.

To qualify as the nearest university to a given student, the institution had to offer programs in the student's mother tongue. For example, a bilingual university such as the University of Ottawa could serve all individuals listing French or English as their mother tongue. In the instances where neither French nor English was listed as the mother tongue, the language of the university was not binding.

The final step was to decide on a specific distance threshold to delineate within commuting distance students from out-of-commuting distance students. Since students differ in their access to transportation and preferences for commuting time, the threshold (or "break-even distance") may vary substantially from student to student. The threshold selected in this study is one beyond which it may be very difficult, if not impossible for the vast majority of students to *be able to* commute on a daily basis. This threshold is set at 80 km of straight-line distance. This necessarily corresponds to more than 80 km of actual driving distance (unless there is a straight road with no turns or hills separating the student's home and the nearest university). As we shall see, living between 40 and 80 km appears to be a sufficient deterrent to attending university for many students, although some of these students are obviously within commuting distance. All results are thus broken down into three groups: 0 to 40 km (within commuting distance), 40 to 80 km (possibly out-of-commuting distance, depending on whether the student has access to a car, class schedules, the precise nature of the geography separating the student's home and the university, etc.), and 80 km or more (out-of-

[8] The analysis was also conducted on the 101 institutions, yielding only very minor changes in the results (since many of the 30 excluded institutions were in large centres anyway). Note that some colleges include university transfer credits, but these are more common in British Columbia and Alberta, and generally only apply to selected courses. Provincial level results would not be reliable due to low sample sizes.

commuting distance)[9]. The main focus, however, will be on the distinction between living within 40 km and beyond 80 km from a university.

If 80 km is indeed a sufficient deterrent for the vast majority of students, then the vast majority of university students must live within 80 km of the nearest university. Unfortunately, SLID (and any other Canadian data source) provides no answers to this question since university students may be grouped in the same household as their parents if they lived with them a substantial amount of time during the year (such as during the summer break). The only marginally comparable data available relates to the commuting distance to work from the 1996 Census (in kilometers of straight-line distance). Only 17.7% of Canadian workers commuted 20 km or more to work (one way). It thus seems plausible that 80 km is a significant deterrent for the vast majority of commuters, whether it be work or school related[10,11].

The set of variables used in the analysis include:

University participation – a dummy variable indicating university participation within two years of year "t" (shortly after high school).

Non-university post-secondary participation – a dummy variable indicating participation in non-university post-secondary schooling within two years of year "t"; pertains only to students who did not attend university.

Distance to school – three dummy variables indicating whether the student lives within 40 km, between 40 and 80 km, or 80 km or more from a university while in high school.

Rural – a dummy variable indicating rural, as opposed to urban status.

Family income – dummy variables indicating the income tier of the student's economic family while in high school. Family incomes are classified by tiers within the five standard area sizes of residence to (partially) account for differences in the cost of living[12]. The five sizes include rural, small urban (under 30,000 people), 30,000-99,999 people, 100,000-499,999 people, and 500,000 or more people. The middle income tier is the omitted category. Note that the income is adjusted for the size of the family in order to account for economies of scale associated with larger families. The precise adjustment consists of dividing family income by the square root of the size of the family. A measure of wealth would be a superior measure of financial resources, but this is not available.

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[9] Andres and Looker (2001) also define three groups, but according to actual driving distance: within 50 km, 50 to 100 km, and 100 km or more. In most instances, these cut-offs correspond roughly to the driving distances implied by the cut-offs used in the current study.

[10] Statistics Canada catalogue no. 93F0027XDB96018 (from the Nation Series).

[11] Of course, commuting to work is not the same as commuting to school - places of work are obviously more spread out than universities are. On the other hand, students may have the same level of access to a vehicle as the general working population.

[12] The results are robust to calculating the family income tier across the entire sample.

Parental education – dummy variables indicating the different combinations of parental possession of a university degree (both parents have a degree, just the father has a degree, just the mother has a degree, neither has a degree – the omitted category, and don't know). The cases where the student didn't know were included and controlled for in order to preserve an adequate sample size[13].

Female – a dummy variable to account for differences in university participation between the sexes.

Province – dummy variables indicating the province the student lived in while in high school (year "t"), with Ontario being the omitted category. This can capture inherent differences in university participation across provinces, either due to differences in student composition, differences in economic conditions across provinces, differences in tuition fees across provinces, or differences in the academic requirements for university admittance (especially important for Quebec and Ontario students).

Year – a series of dummy variables indicating the earliest year of eligibility for university participation in one's province (year "t+2"). This can capture trends in other factors that may affect university participation (e.g. improving economic conditions or rising tuition fees in the 1990s).

The sample means of all variables used in the analysis appear below in Table 1. Overall, 19% of high school students attended university within two years, while 23% of students attended some other form of post-secondary institution. The families of students in our sample tend to have higher incomes than other Canadian families, which is expected given the implied age of the parents (the student must be at least 15 years old). For 20% of high school students, a university cannot be found within 80 km of their home. A further 15% live beyond 40 km from a university. Recall that this includes universities of general interest to most students, and offering programs in the mother tongue of the student (restriction applies to English or French speaking people only). Note the preponderance of students observed in 1998 (regarding university participation) relative to other years. This is the result of the overlapping SLID panels that began in 1996, and the fact that university participation in 1998 was observed for students still in high school in 1996. Note that the sample drops again in 1999 since the first panel ended in 1998. The sampling weights are designed to adjust for this asymmetry.

[13] Otherwise, the sample would have declined by 22%. Note that since response is by proxy in SLID, the person answering the question about the students may be the students themselves, the parents, or other members of the household.

Table 1: Sample Means

Attended university	0.193
Attended non-university post-secondary institution	0.232
Top income tier	0.405
Middle income tier	0.334
Bottom income tier	0.261
Rural	0.135
0 - 40 km	0.648
40 - 80 km	0.155
80 km +	0.197
Father and mother have university degree	0.058
Just father has university degree	0.067
Just mother has university degree	0.032
Neither parent has university degree	0.624
Don't know parents education	0.219
Female	0.474
Newfoundland	0.029
Prince-Edward-Island	0.005*
Nova Scotia	0.039
New Brunswick	0.034
Quebec	0.115
Ontario	0.434
Manitoba	0.042
Saskatchewan	0.046
Alberta	0.109
British Columbia	0.146
1995	0.117
1996	0.184
1997	0.159
1998	0.357
1999	0.184
Sample size	2,087

** Estimate should be viewed with caution.*

An interesting result from Table 1 relates to the larger proportion of students living out-of-commuting distance (80 km or more) than in rural areas. Table 2 shows how the use of an urban/rural indicator can be misleading as a proxy for distance to school. About one-sixth (17%) of rural students live within 40 km from a university. A further 33% live between 40 and 80 km from a university. Conversely, 50% of students in urban areas with fewer than 30,000 people and 24% of students in urban areas with 30,000 to 99,999 people live out-of-commuting distance from a university (80 km or more)[14]. Since some urban dwelling students are not served by a university and some rural dwelling students are served by a university, we expect the gap in university participation between urban and rural dwelling students to be smaller than the gap that exists between students living within and out-of-commuting distance.

Table 2: Distribution of Area Size of Residence by Distance to Nearest University

	Sample	0 - 40 km	40 - 80 km	80 km +	Total
Rural	495	0.172	0.325	0.503	1.000
Urban: 0 to 29,999	492	0.191	0.306	0.503	1.000
Urban: 30,000 to 99,999	299	0.425	0.338	0.237	1.000
Urban: 100,000 to 499,999	469	0.875	0.088	0.036*	1.000
Urban: 500,000 or more	332	0.950	0.012*	0.038*	1.000

** Estimate should be viewed with caution.*

[14] At first glance, the small percentage of large urban dwelling students who are out-of-commuting distance from a university may seem puzzling; note, however, that these are students who live out-of-commuting distance from a university that offers programs in their mother tongue. For example, anglophone students in Quebec City necessarily live out-of-commuting distance from a university offering programs in their mother tongue (since there are no English language universities in and around Quebec City).

3. Results

3.1 The geographic location of universities

Where are Canadian universities located? We begin with a provincial breakdown of undergraduate enrolment per capita for the 71 universities of general interest to students (Table 3):

Table 3: Undergraduate Student Enrolment Per Capita by Province*

Province	Number of universities	Undergraduate enrolment	Population	Enrolment per capita
Newfoundland	2	14,238	540,051	0.0264
Prince-Edward-Island	1	2,848	137,856	0.0207
Nova Scotia	8	32,739	942,183	0.0347
New Brunswick	6	18,684	754,756	0.0248
Quebec	12	169,653	7,359,373	0.0231
Ontario	22	278,449	11,573,026	0.0241
Manitoba	4	29,904	1,143,239	0.0262
Saskatchewan	3	28,090	1,024,540	0.0274
Alberta	4	56,111	2,972,361	0.0189
British Columbia	9	93,585	4,039,207	0.0232
Canada	71	724,301	30,486,592	0.0238

Notes: enrolment numbers available at http://www.aucc.ca; population numbers refer to December, 1999 excludes special interest institutions (30 exclusions out of 101 institutions, accounting for 9% of undergraduate student body).

Enrolment per capita ranges from 1.89% in Alberta to 3.47% in Nova Scotia. Note in the case of Nova Scotia that not only is the enrolment per capita the highest in the country, there is also a relatively large number of institutions (eight in the final sample) spread across a relatively small province (in terms of land area). This of course may be one reason why enrolment rates are so high in this province. Also note that Newfoundland has two universities serving a relatively large province[15] and Saskatchewan has three universities serving mainly the southern portion of a large province. Prince-Edward-Island, on the other hand, has only one university, but the territory served is relatively small.

A more interesting question related to the analysis in this paper is "Where are high school students located relative to the nearest university?" Table 1 answered this question for Canada as a whole. Overall, 20% of Canadian students live out-of-commuting distance (80 km or more), while 15% live between 40 and 80 km away from a university. Breaking these numbers down by province may lead to unreliable estimates, but one way around this is to report the geographic location of the full population relative to universities, which for Canada as a whole, exhibits the same distribution as high school students. Table 4 shows the proportion of the full population in 1996 living within the three distance ranges from a university. Recall that "distance" refers to the number of kilometres of

[15] The two universities are Memorial University in St-John's and its satellite campus in Corner Brook (Sir Wilfred Grenfell College).

the straight line joining the student's home and the nearest university (using formula (1)). The actual driving distance may be substantially longer, depending on the complexity of the path to school, the frequency of hills and bumps in the road, speed limits, etc.

Table 4: Distribution of Population in 1996 by Distance to Nearest University

Province	Sample	0 - 40 km	40 - 80 km	80 km +	Total
Newfoundland	3,588	0.429	0.147	0.425	1.000
Prince-Edward-Island	1,875	0.545	0.315	0.140	1.000
Nova Scotia	4,790	0.629	0.243	0.127	1.000
New Brunswick	4,535	0.588	0.210	0.202	1.000
Quebec	13,470	0.604	0.167	0.228	1.000
Ontario	20,744	0.774	0.133	0.093	1.000
Manitoba	4,858	0.654	0.095	0.251	1.000
Saskatchewan	4,729	0.408	0.072	0.519	1.000
Alberta	6,151	0.701	0.052	0.247	1.000
British Columbia	6,367	0.666	0.102	0.232	1.000
Canada	71,107	0.674	0.132	0.194	1.000

The provincial variation in geographic distance to university is considerable. At one end of the spectrum, 52% of Saskatchewan residents and 42% of Newfoundland residents live beyond 80 km from a university. At the other end, only 9% of Ontario residents, 13% of Nova Scotia residents, and 14% of Prince-Edward-Island residents live beyond 80 km from a university.

3.2 Distance to school and university participation

3.2.1 Descriptive analysis

Looking first at the raw data, Table 5 shows university and non-university post-secondary participation rates by their distance to the nearest university. University participation decreases monotonically with distance to school, going from 23% (within 40 km), to 15% (between 40 and 80 km), and finally to 11% (beyond 80 km). Students living further away, however, are more likely to attend a non-university post-secondary institution. On balance, overall post-secondary participation rates are not dependent on distance to university. But is this a favourable outcome for those living away from universities? The answer depends on how substitutable a university education is with other forms of post-secondary education. For some, university may not offer programs leading to one's career path, and college or trade/vocational schools may be preferable. Of course, the same could be said about college or trade/vocational schools, which in some cases may be the only affordable option. What we do know with certainty is the strong earnings advantage of a university education over a college or trade/vocational education (see Statistics Canada, 1997). The remainder of the study focuses strictly on university participation, thus combining non-university post-secondary participation and no post-secondary participation at all.

Table 5: University and non-University Post-secondary Participation by Distance to Nearest University

Distance	Sample	University	Non-university post-secondary	All post-secondary
0 - 40 km	1,049	0.227	0.205	0.431
40 - 80 km	392	0.154	0.286	0.439
80 km +	646	0.111	0.282	0.393
Urban	1,592	0.197	0.226	0.422
Rural	495	0.168	0.275	0.443

Table 5 also demonstrates that the university participation gap between students living within and out-of-commuting distance is considerably larger than the participation gap that exists between urban and rural dwelling students (20% of urban dwelling students attend, while 17% of rural dwelling students attend). The difference is largely explained by the fact that many students in small urban areas are not served by a university at all, or at least not by one that is of general interest to most students, while some students in rural areas are actually close to a university (see Table 2).

How does university participation vary across the income distribution? Table 6 shows the proportion attending university for three groups: students in the top, middle, and bottom income tiers. Note that the income tier is calculated within one's areas size of residence in order to account for differences in the costs of living between (but not within) these categories (see the data section).

Roughly 27% of students from upper income families attend university shortly after high school, which is about 1.5 times more than students in middle income families (18%), and about 3 times more than students in lower income families (9%). Distance to school appears to matter for students across the entire income distribution, but more so for students from lower income families. In the top tier, out-of-commuting distance students (80 km or more) are about 59% as likely to attend university as within commuting distance students (within 40 km). The relative probability falls slightly to 51% in the middle tier, but the fall is much further in the bottom tier (25%). From the raw data, it appears that students in lower income families are more disadvantaged in attending university when living too far to commute to the local school.

Table 6: University Participation by Income Tier and Distance to School

Income tier	Sample	Proportion attending	Distance	Sample	Proportion attending
Top	802	0.267	0 - 40 km	411	0.314
			40 - 80 km	163	0.176
			80 km +	228	0.184
Middle	744	0.180	0 - 40 km	373	0.204
			40 - 80 km	140	0.184
			80 km +	231	0.104
Bottom	541	0.094	0 - 40 km	265	0.122
			40 - 80 km	89	0.050*
			80 km +	187	0.031*

* *Estimate should be viewed with caution*

Table 7 shows university participation rates according to whether or not at least one parent has a university degree. Students with at least one parent with a university degree are more than twice as likely to attend university. The relative role of distance to school appears to be larger among students whose parents don't have a university degree. Parents without a university degree generally earn less; however, so that these results may simply mirror the earlier result that distance to school mainly affects students in the lowest income tier.

Table 7: University Participation by parental Education and Distance to School

Parent with a degree?	Sample	Proportion attending	Distance	Sample	Proportion attending
Yes	279	0.392	0 - 40 km	169	0.432
			40 - 80 km	49	0.310*
			80 km +	61	0.258*
No/don't know	1,808	0.155	0 - 40 km	880	0.182
			40 - 80 km	343	0.129
			80 km +	585	0.094

* *Estimate should be viewed with caution.*

Table 8 shows the proportion attending university by sex. Females are far more likely to attend university than males, but only when living within 80 km from a university. When out-of-commuting distance (80 km or more), there is virtually no difference in university participation by sex.

Table 8: University Participation by Sex and Distance to School

Income tier	Sample	Proportion attending	Distance	Sample	Proportion attending
Male	1,110	0.157	0 - 40 km	542	0.186
			40 - 80 km	218	0.113
			80 km +	350	0.107
Female	977	0.232	0 - 40 km	507	0.270
			40 - 80 km	174	0.209
			80 km +	296	0.116

In the raw data, it appears that university participation depends on distance to school. Furthermore, distance appears to impact the relationship between participation and other variables, such as family income, parental education, and sex. The next section will verify if these findings hold in a more rigorous analytical framework.

3.2.2 Econometric analysis

Living near a university may provide an affordable alternative to students contemplating a university education: staying at home to save on living and moving costs. But are students who live closer to a university actually more likely to attend? And if so, how does family income come into play? Students in upper or middle income families may not be so deterred by the fact that they must leave the nest to attend university, given that the family may still be able to afford paying for living and moving costs.

In this section, the role of distance to school in university participation is analysed more closely in a logit model. The general model estimated is:

$$(2)\ \text{Ln}\,[P_i/(1-P_i)] = \mathbf{x}_i\beta + \xi_i$$

Where "P" is the probability of university participation two years later (the earliest year of eligibility, under normal circumstances) or earlier, "**x**" is a vector of regressors, and ξ is a random disturbance term. The subscript "i" denotes the student. The regression results for seven specifications of the model are shown below in Table 9.

Table 9: Logistic Regression Results – University Participation

Dependent variable = 1 (if attended university), 0 (else)	Model 1: No distance	Model 2: Add rural	Model 3: Add distance (continuous)	Model 4: Add distance (categorical)	Model 5: Income*dist.	Model 6: Parent. ed.*dist.	Model 7 Sex*dist
Intercept	-2.112 **	-2.091 **	-1.999 **	-1.961 **	-2.038 **	-1.935 **	-1.964
	(-5.73)	(-5.65)	(-5.32)	(-5.18)	(-5.17)	(-4.81)	(-5)
Top income tier	0.331	0.331	0.345	0.347	0.402	0.344	0.356
	(1.73)	(1.73)	(1.8)	(1.79)	(1.62)	(1.76)	(1.84)
Bottom income tier	-0.671 **	-0.673 **	-0.676 **	-0.679 **	-0.454	-0.703 **	-0.675
	(-2.63)	(-2.64)	(-2.66)	(-2.67)	(-1.47)	(-2.77)	(-2.65)
Top income tier*(40-80 km)					-0.684 *		
					(-2.34)		
Middle income tier*(40-80 km)					-0.095		
					(-0.28)		
Bottom income tier*(40-80 km)					-1.105 *		
					(-2.09)		
Top income tier*(80 km +)					-0.514 *		
					(-1.96)		
Middle income tier*(80 km +)					-0.723 **		
					(-2.59)		
Bottom income tier*(80 km +)					-1.693 **		
					(-3.43)		
Rural		-0.229					
		(-1.33)					
Distance (km)			-0.004 **				
			(-2.84)				
Distance^2 (km^2)			$1.7*10^{-6}$ *				
			(2.52)				
40-80 km				-0.523 *			
				(-2.54)			
80 km +				-0.755 **			
				(-4.31)			
Father and mother have degree	1.742 **	1.723 **	1.699 **	1.734 **	1.769 **		1.778
	(5.63)	(5.54)	(5.48)	(5.58)	(5.65)		(5.64)
Just father has degree	0.953 **	0.934 **	0.923 **	0.918 **	0.931 **		0.931
	(3.34)	(3.26)	(3.25)	(3.24)	(3.28)		(3.3)
Just mother has degree	0.964 **	0.952 **	0.898 **	0.869 **	0.895 **		0.864
	(3.24)	(3.21)	(2.99)	(2.86)	(2.94)		(2.84)
Don't know parents education	0.094	0.088	0.080	0.092	0.121		0.090
	(0.28)	(0.26)	(0.24)	(0.27)	(0.36)		(0.27)
Parent with degree						1.240 **	
						(4.92)	
Parents w/o degree or dk*(40-80 km)						-0.428	
						(-1.88)	
Parent with degree*(40-80 km)						-0.692	
						(-1.58)	
Parents w/o degree or dk*(80 km +)						-0.728 **	
						(-3.7)	
Parent with degree*(80 km +)						-0.814 *	
						(-2.05)	

continued ...

Table 9: Logistic Regression Results – University Participation *(concluded)*

Dependent variable = 1 (if attended university), 0 (else)	Model 1: No distance	Model 2: Add rural	Model 3: Add distance (continuous)	Model 4: Add distance (categorical)	Model 5: Income*dist.	Model 6: Parent. ed.*dist.	Model 7: Sex*dist.
Female	0.542 **	0.547 **	0.544 **	0.530 **	0.529 **	0.497 **	0.514 *
	(3.16)	(3.19)	(3.16)	(3.05)	(3.04)	(2.86)	(2.31)
Male*(40-80 km)							-0.815 **
							(-2.77)
Female*(40-80 km)							-0.238
							(-0.83)
Male*(80 km +)							-0.520 *
							(-2.15)
Female*(80 km +)							-0.961 **
							(-3.82)
Newfoundland	0.468	0.547 *	0.663 **	0.751 **	0.767 **	0.702 **	0.733 **
	(1.84)	(2.16)	(2.56)	(2.9)	(2.89)	(2.71)	(2.78)
Prince-Edward-Island	0.747 *	0.809 *	0.731 *	0.777 *	0.747 *	0.741 *	0.810 *
	(2.07)	(2.23)	(2)	(2.04)	(2.01)	(1.96)	(2.05)
Nova Scotia	0.646 *	0.671 *	0.653 *	0.666 *	0.659 *	0.616 *	0.676 *
	(2.4)	(2.5)	(2.43)	(2.48)	(2.44)	(2.33)	(2.5)
New Brunswick	0.317	0.382	0.371	0.430	0.408	0.417	0.410
	(1.25)	(1.52)	(1.48)	(1.7)	(1.6)	(1.67)	(1.61)
Quebec	-2.291 **	-2.284 **	-2.247 **	-2.208 **	-2.222 **	-2.163 **	-2.220 **
	(-4.62)	(-4.6)	(-4.51)	(-4.37)	(-4.4)	(-4.38)	(-4.39)
Manitoba	0.121	0.149	0.218	0.214	0.203	0.217	0.199
	(0.41)	(0.51)	(0.73)	(0.72)	(0.68)	(0.74)	(0.67)
Saskatchewan	-0.051	-0.010	0.194	0.236	0.243	0.165	0.225
	(-0.2)	(-0.04)	(0.75)	(0.91)	(0.92)	(0.62)	(0.87)
Alberta	-0.460	-0.459	-0.409	-0.404	-0.414	-0.445	-0.414
	(-1.7)	(-1.69)	(-1.49)	(-1.48)	(-1.51)	(-1.62)	(-1.52)
British Columbia	-0.735 *	-0.738 *	-0.689 *	-0.693 *	-0.711 *	-0.760 *	-0.686 *
	(-2.29)	(-2.31)	(-2.15)	(-2.15)	(-2.2)	(-2.34)	(-2.12)
1996	0.652	0.657	0.655	0.630	0.626	0.700	0.641
	(1.33)	(1.34)	(1.35)	(1.29)	(1.28)	(1.8)	(1.31)
1997	0.574	0.578	0.585	0.586	0.586	0.641	0.591
	(1.41)	(1.42)	(1.44)	(1.46)	(1.46)	(1.68)	(1.47)
1998	0.265	0.268	0.282	0.280	0.291	0.266	0.285
	(0.8)	(0.81)	(0.85)	(0.85)	(0.88)	(0.78)	(0.86)
1999	0.028	0.026	0.044	0.031	0.031	0.067	0.027
	(0.08)	(0.08)	(0.13)	(0.09)	(0.09)	(0.19)	(0.08)
N				2,087			
-2*log(likelihood ratio)	1,773.05	1,771.54	1,761.75	1,751.62	1,740.71	1,762.09	1,746.10

*Notes: z statistics in parentheses; ** significant at 1%; * significant at 5%*

3.2.2.1 Model 1: No distance

The explanatory variables included in the first model are family income, parental education, sex, province, and the year by which we observe whether the student attended university or not. Distance information is not included for the moment. Relative to the middle income tier, students in the top income tier are more likely to attend university, while students in the bottom tier are less likely to attend. The magnitude of the coefficient on the bottom tier variable is not only larger (in absolute value) than that of the top tier, it is also significant at 1% (compared to 10% for the top tier).

Parental possession of a university degree is also associated with a higher probability of university participation. This is especially true if both parents have a degree, but it also holds true to a lesser extent if only one parent possesses a degree. It does not matter whether it is the mother or the father

who possesses the university degree. Note that the control variable for respondents who did not know the parents level of education has a positive sign, but is small in magnitude and not significantly different than the reference category (neither parent has a degree).

Females are significantly more likely to attend university than males. This may not come as a surprise given that female participation in university has been steadily rising for some time, to a point where they now consist of the majority of the undergraduate student body in Canada (57% in the 1999/2000 academic year)[16].

Many provincial coefficients are not significant, indicating that students in these provinces are about as likely as Ontario students (the reference category) are to attend university. There are four exceptions, however, including Prince-Edward-Island, Nova Scotia, Quebec, and British Columbia. Prince-Edward-Island and Nova Scotia students are the most likely to attend university, which is perhaps not surprising given that they are generally among the most closely situated to universities (see Table 4). Quebec students, on the other hand, are far less likely to attend university. This may be due to two reasons. First, high school students in Quebec have to attend at least two years of the general stream of CEGEP prior to attending university. This may involve moving from the home if there is no CEGEP nearby, which implies moving and living costs. Furthermore, some students take more than two years to complete their CEGEP. A more accurate picture of university participation among Quebec students would thus require a longer outlook. In a separate specification, university participation up to and including year "t+3" was examined, which came at a cost of losing roughly 40% of the sample size (t=1997 had to be dropped). The regression coefficient on the Quebec variable was still statistically significant, but the magnitude did fall from about -2.3 to -1.7. Finally, students in British Columbia were also less likely to attend university than Ontario students, but not quite to the extent as Quebec students.

3.2.2.2 Model 2: Add urban/rural indicator

In Model 2, an urban/rural indicator variable has been added. Otherwise, the model is exactly the same as the first one.

Rural dwelling students are less likely to attend university, but only slightly so. Moreover, the difference is not statistically significant[17]. As mentioned before, not all urban areas are served by a university, while some rural areas are actually quite close to a university. All of the other coefficients remain very stable (relative to Model 1).

3.2.2.3 Model 3: Add distance to school (continuous)

[16] See CANSIM tables 580602, 580603, 580701, and 580702 for more details on university enrolment.

[17] Butlin (1999) and Christofides, Cirello, and Hoy (2001) found a significant relationship, possibly due to a different research design and/or the larger databases they use (the Survey of Consumer Finances and the Survey of School Leavers, respectively). Unfortunately, neither of these databases provides the researcher with the postal codes of students.

The specification for Model 3 includes distance and distance^2 as opposed to the rural dummy variable. University participation declines with distance to school, but at a diminishing rate. This is consistent with the notion that beyond some threshold, added distance may not matter as much since it is simply too far to commute. So, after controlling for family income, parental education, sex, province, and the year of possible attendance, our descriptive finding that distance to school matters still holds (Table 5). As expected, distance to school is more strongly associated with university participation than is the urban/rural status.

The other coefficients remain more or less the same in magnitude as in the two previous models, with two exceptions. Students in Newfoundland and in Saskatchewan now have a greater probability of attending university. Recall that distance to school is an issue in these two provinces, since 42% of the Newfoundland population and 52% of the Saskatchewan population live beyond 80 km from a university. But in the first model, there was no control for distance. Model 2 partially corrected for this by including an urban/rural indicator variable, but this only led to marginal increases in the Newfoundland and Saskatchewan coefficients. By controlling for the student's true geographic location relative to the nearest school (Model 3), the estimated odds of attending university rise in these two provinces.

3.2.2.4 Model 4: Add distance to school (categorical)

In Model 4, a series of categorical distance to school variables replaces the continuous distance variables. There are two reasons why this strategy is applied. In Model 3, it was shown that added distance has less of a negative impact as we move further away from a university's reach, so that perhaps a fixed threshold is appropriate from a conceptual point of view. Furthermore, specifying distance in ranges will facilitate the graphical display of predicted probabilities (below). Henceforth, any mention of the distance variables shall make reference to the categorical versions.

Students living out-of-commuting distance (80 km or more) and possibly out-of-commuting distance (40 to 80 km) are considerably less likely to attend university than students living within commuting distance (less than 40 km). The coefficients are also significant at 5% (40 to 80 km) and 1% (80 km or more)[18].

3.2.2.5 Model 5: Interact family income with distance to school

In Model 5, family income is interacted with the (categorical) distance to school variables. This allows one to see how the role of distance varies across the income distribution.

Relative to living within 40 km from a university, living beyond 80 km from a university has a negative impact on university participation for all three income groups. The largest impact is by far at the bottom (*Bottom income tier*(80 km +)*), but the top and middle of the income distribution also appear to be deterred by this distance. Living between 40 and 80 km from a university also appears to affect the bottom of the income distribution the most (*Bottom income tier*(40-80 km)*).

[18] There is no significant difference between 40 to 80 km from a university and beyond 80 km from a university.

As mentioned before, it is not so clear that students living between 40 and 80 km are truly out-of-commuting distance, so these results are somewhat more difficult to interpret[19].

3.2.2.6 Model 6: Interact parental education with distance to school

In Model 6, parental education is interacted with the distance to school variables. In this regression only, parental education was grouped in two categories (for ease of presentation): at least one parent with a degree, and no parent with a degree or don't know. Living beyond 80 km has a negative and statistically significant effect on university participation for students with and without a university-educated parent (*Parent with degree*(80 km +)* and *Parent w/o degree or dk*(80 km +)*). Recall that in the raw data, it appeared that distance to school had a more negative impact on the university participate rate of students without a university-educated parent. After controlling for family income, however, this result no longer holds.

3.2.2.7 Model 7: Interact sex with distance to school

Do males and females react differently to geographic constraints? Model 7 attempts to answer this question by interacting the female variable with the distance to school variables. In Models 1 through 6, the female coefficient has always been positive and significant (females are more likely to attend university than males). In Model 7, however, females are more negatively impacted by living beyond 80 km from a university (*Female*(80 km +)* is more negative than *Male*(80 km +)*). Andres and Looker (2001) also find that females are relatively more deterred by distance in attending university.

3.2.3 The magnitude of the role of distance to school

So far, we have examined the role of distance to school in a series of logit models. To better appreciate the magnitude of this role, predicted probabilities of university participation were generated from the regressions through the general formula:

(3) $P_i = \exp(\mathbf{x_i b})/[1 + \exp(\mathbf{x_i b})]$

Where "P_i" is the predicted probability of an individual attending university, and "$\mathbf{x_i}'\mathbf{b}$" is the linear combination of the regressor variables (at a given set of values $\mathbf{x_i}'$) times the estimated regression coefficients **b**. The predictions are calculated at the individual level, and then averaged out for the entire sample. An alternative technique is to calculate the predicted probability for a representative reference person. However, the marginal effect of a variable on the predicted probability would depend on the reference person (since the predicted probability is a non-linear function of the vector of regressors). Changing the reference person may thus lead to slight changes in the marginal effects. By averaging the individual predicted probabilities over the entire sample, the non-linearity of the marginal effects becomes a non-issue. More specifically, there is no need to try alternate

[19] The samples underlying these results are also much smaller. Although the regression is based on 2,087 observations, only 392 students live between 40 and 80 km from a university in our sample. Breaking this down by income group obviously leads to few cases that are driving the results. In contrast, 646 students in our sample live beyond 80 km from a university.

reference persons since every person (with their own unique characteristics) contributes to the overall prediction.

Chart 1 shows the predicted probabilities of attending university for students living in the three distance bands we have created, generated from model 4. The three probabilities were recovered by counterfactually changing the value of the distance dummy variable in question to "1" for all observations in the sample, and then taking the average of the predicted probabilities over the sample. Although the level of the predicted probability is shown along the vertical axis, the key point is the relative probabilities for each group. In each chart, the predicted probability relative to the first (leftmost) group is denoted within the bar. The predicted probability of participation among students living within 40 km from a university is standardized to 100%. Students living beyond 80 km from a university are only 58% as likely to attend university as students living within 40 km. Students living between 40 and 80 km are only 69% as likely to attend as students living within 40 km. Collectively, students living beyond 40 km from a university (35% of the student population) are only 63% as likely to attend as those living closer to a university[20].

Chart 1: Predicted Probability of University Participation by Distance to School

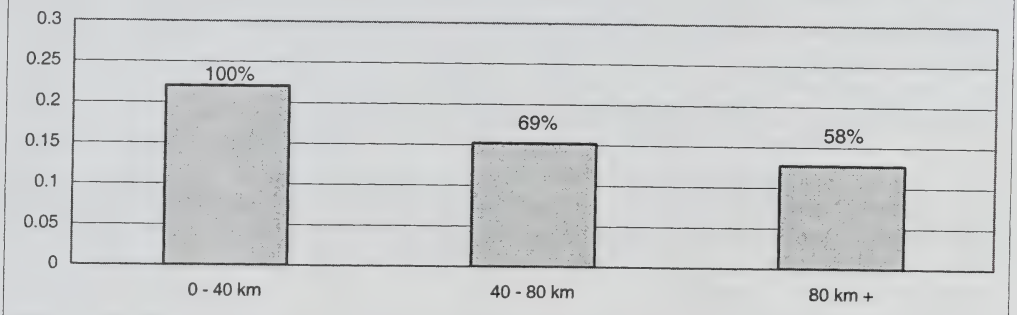
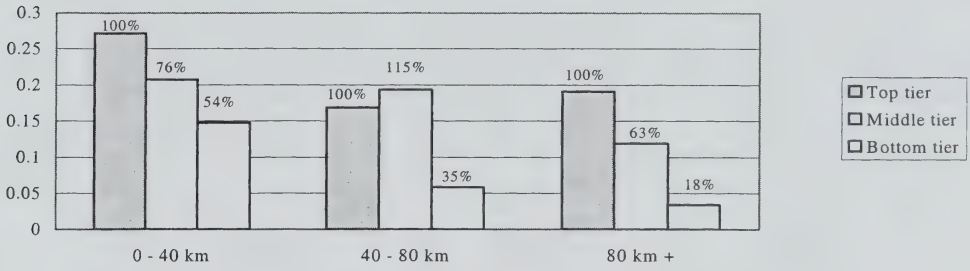


Chart 2 shows the relative propensities to attend across the income distribution for the three distance bands, generated from model 5. Students in the bottom income tier are always substantially less likely to attend university than students in the top income tier, but more so as we move further away from universities. Beyond 80 km from a university, students from upper income families are 5.6 times as likely to attend university as students in lower income families, and 1.6 times as likely to attend as students from middle income families. Even when living between 40 and 80 km from a university, students from upper income families are 2.9 times as likely to attend as students in lower income families. Within 40 km from a university, students from upper income families are 1.9 times as likely to attend as students from lower income families.[21]

[20] A sample-weighted average was used to obtain this figure.

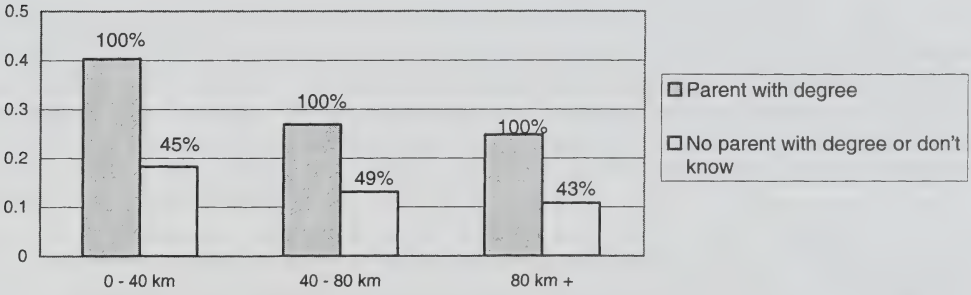
[21] Note that the same general results hold (albeit with different magnitudes) when the income tiers are calculated for all of Canada as opposed to within area sizes of residence.

Chart 2: Predicted probability of university participation by distance to school and family income



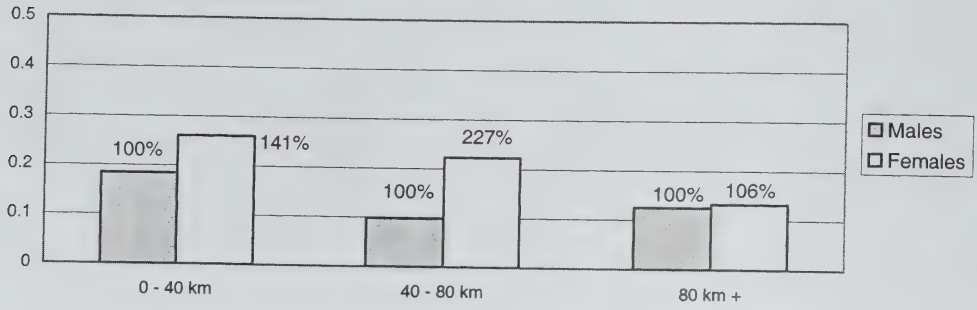
In Chart 3, we see the predicted probabilities of participation among students with and without a university-educated parent (from Model 6). The relative predicted probabilities remain the same regardless of distance to school. In other words, students with and without a university-educated parent are affected to the same extent by distance (once differences in family income have been taken into account).

Chart 3: Predicted Probability of University Participation by Distance to School and Parental Education



The regression results shown in Table 9 also uncovered some interesting differences in the reactions of males and females to distance (Model 7). Chart 4 indicates that females are far more likely to attend university when living within 80 km from a university. Beyond 80 km, however, there is no difference in the predicted probability of university participation among the sexes.

Chart 4: Predicted Probability of University Participation by Distance to School and Sex



4. Conclusion

This study assesses the role of distance to school in university participation. The motivation for the study lies in the fact that high school students who live close to a university can cut their costs substantially by staying at home to attend the local school. Particular interest is paid to the role distance plays in the relationship between university participation and its other correlates, such as family income, parental education, and sex.

The distance between the student's home and the nearest university is calculated by first obtaining the geographic co-ordinates (latitude and longitude) of the student (while in high school), and all Canadian universities that may be of interest to most students (i.e. excluding theological, military, and distance schools, as well as any other institution that may be considered "special interest"). In all, 71 out of 101 degree granting institutions remained in our sample, representing about 91% of the undergraduate student body in Canada. The geographic co-ordinates of both the students and the schools were obtained by using the PCCF+, a program that converts 6 digit postal codes into various geographic units, including geographic co-ordinates. Students were then classified into one of three groups: 0 to 40 km (within commuting distance), 40 to 80 km (possibly out-of-commuting distance), and 80 km or more (out-of-commuting distance). Note that the distance calculated in this study refers to the straight-line distance between two points, and may correspond to a considerably longer driving distance.

For Canada as a whole, 19% of the population lives beyond 80 km of straight-line distance from a university (beyond commuting distance for most) and 13% live between 40 and 80 km from a university (perhaps beyond commuting distance for many). These aggregate numbers mask the tremendous variations across provinces. More than 50% of Saskatchewan residents and more than 40% of Newfoundland residents live more than 80 km from a university. Conversely, a much smaller proportion of the population in Ontario (9%), Nova Scotia (13%) and Prince-Edward Island (14%) live beyond 80 km from a university. After controlling for several factors that are associated with university participation, such as family income, parental education, and sex, students living

beyond 40 km from a university (35% of the student population) are only 63% as likely to attend university shortly after high school as students living within 40 km from a university. Students living beyond 80 km from a university are only 58% as likely to attend as students living within 40 km.

Generally speaking, three types of students are far more likely to attend university: students from upper income families, students with a university-educated parent, and females. But do these relationships hold up within the distance bands created in this study? In general, the answer is yes, but to varying degrees. Within 40 km from a university, students from upper income families are 1.9 times more likely to attend than students from lower income families are. Beyond 80 km, however, the ratio rises to 5.6. Students with and without a university-educated parent are affected to the same extent by distance (once differences in family income have been taken into account). Finally, the relative advantage of females in attending university vanishes when we look at students living beyond 80 km from a university. Overall, then, most of the negative impact of distance on university participation can be attributed to two groups: students from lower income families and females.

Why does university participation vary by distance to school? There are at least three possible reasons why this is the case. The first is *financial costs*, which was used as a motivating factor for this study. Students living within commuting distance have a clear cost-saving advantage over students living out-of-commuting distance. For others, there may be *emotional costs* associated with leaving home to attend university. Students may have a social network of family and friends that they may not be willing to give up in order to attend university, although there is no way to assess this in the data[22]. A third reason may be that students in outlying areas simply don't see the benefits from a university education since fewer people hold a degree[23]. In other words, high school students may be subjected to a *neighbourhood educational attainment effect*. In assessing the relationship between distance to school and university participation, it is important to stress the correlative (as opposed to causal) nature of this association. Without a random experiment, whereby families are randomly assigned a home at a given distance away from a university, there is no easy way to determine the causal impact of distance to school on university participation. Nevertheless, both the data and theoretical expectations support the notion that students living further away are disadvantaged in accessing university.

Why does distance affect the relationship between university participation and its other correlates (namely, family income and sex)? The answers can be framed around the possible reasons underlying the general relationship between university participation and distance. Students from lower income families, for example, may be less likely to attend when they must move out of the home since their families may not be able to afford the moving and living costs. Distance may be a greater deterrent among the female student population if there are fewer female role models in outlying areas. The data provides some *limited* support for this notion, as mothers of students living within 40 km from a university in our sample are 65% as likely to hold a degree as the fathers, but

[22] McGrath (1996) finds that one's attachment to the community is an obstacle in university participation.

[23] In fact, 18% of students living within 40 km from a university have at least one parent with a university degree, compared to only 11% of students living beyond 80 km.

are only 56% as likely to a hold a degree as the fathers when living beyond 80 km from a university. Another reason may relate to financial costs. If females expect a lower net present value of lifetime earnings from a university education, they may be less willing than males to front the costs of moving and living away from home[24]. A third possible reason underlying the different reactions of males and females to distance relate to emotional costs. If females place more value on their network of family and friends, they may be less willing to leave home to attend university. Unfortunately, the data provides no means to tests this notion.

This study has highlighted a possible obstacle in the ability of a university education to reduce earnings inequality in Canada. In particular, students from lower income families are less likely to attend university than other students, *especially* if they live out-of-commuting distance. This may be due to the higher costs associated with leaving home to attend university: students in lower income families may not be able to afford these costs. The results also have implications for the gender earnings gap. Females have increased their presence in Canadian universities, which may eventually result in a reduction of the earnings gap. This is more likely to happen among students raised within commuting distance from a university, where females are far more likely to attend university than males. For a variety of reasons, females living out-of-commuting distance are no more likely to attend university than males.

A point to note about this study is that students living further away from a university are more likely to attend a non-university post-secondary institution, so that on balance, overall post-secondary participation rates are similar to students living closer to universities. Attending a non-university post-secondary institution may be a second choice for students who live too far to attend university, given the earnings advantage of a university education (holding all else constant). Some interesting future work could look at whether students living away from university, but close to college tend to settle for a college education.

[24] Females bachelor's graduates still earn considerably less than males, possibly due to a different distribution of chosen fields of study (Finnie and Frenette, 2002). Females are also more likely to interrupt their career to raise children.

Appendix: List of Degree-Granting Institutions *

Institution	Postal Code	Theological	Military	Special	English	French	Selected
Memorial University	A1C5S7	0	0	0	1	0	1
Memorial University - Sir Wilfred Grenfell College	A2H6P9	0	0	0	1	0	1
Acadia University	B0P1X0	0	0	0	1	0	1
Université Sainte-Anne	B0W1M0	0	0	0	0	1	1
University College of Cape Breton	B1M1A2	0	0	0	1	0	1
St. Francis Xavier University	B2G2W5	0	0	0	1	0	1
Nova Scotia Agricultural College	B2N5E3	0	0	1	1	0	0
University of King's College	B3H2A1	0	0	0	1	0	1
St. Mary's University	B3H3C3	0	0	0	1	0	1
Dalhousie University	B3H3J5	0	0	0	1	0	1
Nova Scotia College of Art and Design	B3J3J6	0	0	1	1	0	0
Mount Saint Vincent University	B3M2J6	0	0	0	1	0	1
University of Prince Edward Island	C1A4P3	0	0	0	1	0	1
Université de Moncton	E1A3E9	0	0	0	0	1	1
University of New Brunswick at St. John	E2L4L5	0	0	0	1	0	1
University of New Brunswick	E3B5A3	0	0	0	1	0	1
St. Thomas University	E3B5G3	1	0	1	1	0	0
Université de Moncton à Edmunston	E3V2S8	0	0	0	0	1	1
Mount Allison University	E4L1E4	0	0	0	1	0	1
Université de Moncton à Shippagan	E8S1P6	0	0	0	0	1	1
Université Laval	G1K7P4	0	0	0	0	1	1
Université du Qué. - École nationale d'adm. publique	G1K9E5	0	0	1	0	1	0
Université du Qué. - Télé-Université	G1K9H5	0	0	1	0	1	0
Université du Qué. - Inst. Nat. de la recherche scientifique	G1V4C7	0	0	1	0	1	0
Université du Qué. à Rimouski	G5L3A1	0	0	0	0	1	1
Université du Qué. à Chicoutimi	G7H2B1	0	0	0	0	1	1
Université du Qué. à Trois Rivières	G9A5H7	0	0	0	0	1	1
McGill University	H3A2T5	0	0	0	1	0	1
Université du Québec - École de technologie supérieure	H3C1K3	0	0	1	0	1	0
École Polytechnique de Montréal	H3C3A7	0	0	1	0	1	0
Université de Montréal	H3C3J7	0	0	0	0	1	1
Université du Québec à Montréal	H3C3P8	0	0	0	0	1	1
Concordia University	H3G1M8	0	0	0	1	0	1
École des Hautes Études Commerciales	H3T2A7	0	0	1	0	1	0
Université de Sherbrooke	J1K2R1	0	0	0	1	0	1
Bishop's University	J1M1Z7	0	0	0	1	0	1
Université du Québec à Hull	J8X3X7	0	0	0	0	1	1
Université du Québec en Abitibi-Témiscamingue	J9X5E4	0	0	0	0	1	1
University of Ottawa	K1N6N5	0	0	0	1	1	1
Collège Dominicain de Philosophie et de Théologie	K1R7G3	1	0	0	0	1	0
Saint-Paul University	K1S1C4	1	0	0	1	0	0
Carleton University	K1S5B6	0	0	0	1	0	1
Royal Military College of Canada	K7K7B4	0	1	0	1	0	0
Queen's University at Kingston	K7L3N6	0	0	0	1	0	1
Trent University	K9J7B8	0	0	0	1	0	1
Brock University	L2S3A1	0	0	0	1	0	1
McMaster University	L8S4L8	0	0	0	1	0	1
Redeemer University College	L9K1J4	1	0	0	1	0	0
York University	M3J1P3	0	0	0	1	0	1
Ryerson University	M5B2K3	0	0	0	1	0	1
University of Toronto	M5S1A1	0	0	0	1	0	1
University of Trinity College	M5S1H8	0	0	1	1	0	0
University of St. Michael's College	M5S1J4	1	0	0	1	0	0

Continued ...

List of Degree-Granting Institutions *

Institution	Postal Code	Theological	Military	Special	English	French	Selected
Victoria University	M5S1K7	0	0	1	1	0	0
University of Guelph	N1G2W1	0	0	0	1	0	1
Wilfrid Laurier University	N2L3C5	0	0	0	1	0	1
University of Waterloo	N2L3G1	0	0	0	1	0	1
St. Jerome's University	N2L3G5	0	0	0	1	0	1
Kings College	N6A2M3	0	0	0	1	0	1
The University of Western Ontario	N6A3K7	0	0	0	1	0	1
Brescia University	N6G1H2	0	0	1	1	0	0
Huron University College	N6G1H3	0	0	0	1	0	1
University of Windsor	N9B3P4	0	0	0	1	0	1
Nipissing University	P1B8L7	0	0	0	1	0	1
Laurentian University of Sudbury	P3E2C6	0	0	0	1	1	1
Algoma University College	P6A2G4	0	0	0	1	0	1
Université de Hearst	P0L1N0	0	0	0	0	1	1
University of Sudbury	P3E2C6	1	0	0	1	1	0
Lakehead University	P7B5E1	0	0	0	1	0	1
Collège Universitaire de Saint-Boniface	R2H0H7	0	0	0	1	0	1
The University of Winnipeg	R3B2E9	0	0	0	1	0	1
The University of Manitoba	R3T2N2	0	0	0	1	0	1
Brandon University	R7A6A9	0	0	0	1	0	1
Campion College	S4S0A2	0	0	0	1	0	1
Luther College	S4S0A2	1	0	0	1	0	0
The University of Regina	S4S0A2	0	0	0	1	0	1
Saskatchewan Indian Federated College	S4S0A2	0	0	1	1	0	0
St. Thomas More College	S7N0W6	1	0	1	1	0	0
University of Saskatchewan	S7N5A2	0	0	0	1	0	1
The University of Lethbridge	T1K3M4	0	0	0	1	0	1
University of Calgary	T2N1N4	0	0	0	1	0	1
Augustana University College	T4V2R3	0	0	0	1	0	1
Concordia University College of Alberta	T5B4E4	1	0	0	1	0	0
The King's University College	T6B2H3	1	0	0	1	0	0
University of Alberta	T6G2E1	0	0	0	1	0	1
Athabasca University	T9S3A3	0	0	1	1	0	0
Okanagan University College	V1V1V7	0	0	0	1	0	1
University College of the Cariboo	V2C5N3	0	0	0	1	0	1
University of Northern British Columbia - Abbotsford	V2N4Z9	0	0	0	1	0	1
University of Northern British Columbia - Chilliwack	V2P6T4	0	0	0	1	0	1
University of Northern British Columbia - Mission	V2V7B1	0	0	1	1	0	0
University of Northern British Columbia - Hope	V0X1L0	0	0	1	1	0	0
University of Northern British Columbia - Agassiz	V0M1A0	0	0	1	1	0	0
University College of the Fraser Valley	V2S7M9	0	0	0	1	0	1
Trinity Western University	V2Y1Y1	1	0	0	1	0	0
Simon Fraser University	V5A1S6	0	0	0	1	0	1
British Columbia Open University	V5G4S8	0	0	1	1	0	0
University of British Columbia	V6T1Z1	0	0	0	1	0	1
University of Victoria	V8W2Y2	0	0	0	1	0	1
Royal Roads University	V9B5Y2	0	1	0	1	0	0
Malaspina University-College	V9R5S5	0	0	0	1	0	1

** Note: A "1" means "yes", and a "0" means "no"; campuses and affiliate institutions were included in the analysis in cases when they offered a wide array of undergraduate programs.*

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